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Evaluating Material Management Practices within Construction Projects Undertaken by the Zambia National Building Society (ZNBS)

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Abstract

In the realm of developing economies, the construction industry holds paramount importance, acting as a vital cog in the wheel of economic growth and infrastructure development (Jose, 2013) [27]. Notably, the construction sector significantly contributes to national development by enhancing essential infrastructure and providing employment opportunities. The general objective of the study is to analyze and evaluate the material management practices within construction projects undertaken by the Zambia National Building Society (NBS).Specific Objectives were; To identify the specific material management practices employed by the Zambia National Building Society (NBS) in the construction of housing projects; To determine the factors unique to the Zambia National Building Society (NBS) context that influence the selection of material management strategies in construction projects.; To assess the effectiveness of material management strategies utilized by the Zambia National Building Society (NBS) in construction projects; To analyze the specific challenges encountered by the Zambia National Building Society (NBS) in implementing material management strategies within construction projects. The research design selected for this study is a case study, which has been widely recognized for its suitability in investigating complex phenomena within real-life contexts. The sample size for this study will be determined based on the principles of saturation in qualitative research. The sampling procedure involved identifying 100 participants through professional networks, industry associations, and recommendations from key informants. The research instruments for this study included semi-structured interviews and questionnaires. The data collection procedure involved several steps to ensure comprehensive gathering of information relevant to the research objectives. The data analysis will involved a combination of thematic content analysis for qualitative data and statistical graphical presentation for quantitative data. The mean rating for effective procurement planning (4.3) is significantly higher than the ineffective rating (2.8), with a T-value of 5.12 and a p-value of < 0.001, indicating high effectiveness. The mean rating for effective inventory management (4.0) is significantly higher than the ineffective rating (2.9), with a T-value of 4.75 and a p-value of < 0.001, showing its effectiveness in reducing material wastage. The mean rating for effective vendor management (4.2) is significantly higher than the ineffective rating (3.0), with a T-value of 4.89 and a p-value of < 0.001, highlighting the importance of reliable vendor relationships. The mean rating for effective material handling and storage (4.1) is significantly higher than the ineffective rating (2.7), with a T-value of 5.03 and a p-value of < 0.001, indicating effective material protection practices. The mean rating for effective waste management (3.9) is significantly higher than the ineffective rating (2.6), with a T-value of 4.55 and a p-value of < 0.001, showing its success in minimizing waste. The analysis identifies several key material management practices employed by the Zambia National Building Society in their housing projects. These practices include procurement planning, inventory management, vendor management, material handling and storage, and waste management. The independent T-test analysis confirms that these practices are significantly effective, contributing positively to the successful execution of construction projects. The findings underscore the importance of these practices in enhancing material management efficiency and project outcomes. From the findings most of the companies lack adequate planning of the material with only a small percentage adopting an integrated management plan. A systematic and integrated approach is therefore needed to manage materials and minimize the costs associated with poor materials management.

Keywords: Management, Zambia National Building Society (ZNBS), Zambia

1. Introduction

1.1 Background of the Study

In the realm of developing economies, the construction industry holds paramount importance, acting as a vital cog in the wheel of economic growth and infrastructure development (Jose, 2013) [27]. Notably, the construction sector significantly contributes to national development by enhancing essential infrastructure and providing employment opportunities. Within this sector, effective material management stands out as a critical aspect that plays a pivotal role in the smooth functioning of construction

processes. Material management is a fundamental aspect of construction project management, encompassing the planning, procurement, storage, transportation, and utilization of materials throughout the project lifecycle (Chishinga, 2003) [15]. Effective material management ensures that construction projects have the necessary resources available at the right time, in the right quantity, and at the right location, thereby optimizing project efficiency and minimizing costs (Chipeta, 2001) [12]. Efficient material management practices contribute significantly to project success by reducing delays, minimizing waste, enhancing productivity, and improving overall project performance.

In construction projects, effective material management plays a pivotal role in determining project success and overall performance. Material management encompasses various activities, including procurement, inventory control, transportation, storage, and disposal of materials, all of which significantly influence project outcomes (Alinaitwe & Apolot, 2015) [5]. Proper material management ensures that construction projects have the necessary resources available when needed, thereby minimizing delays and disruptions. One critical aspect of material management is procurement, which involves sourcing and acquiring materials required for construction activities. Efficient procurement practices, such as identifying reliable suppliers, negotiating favorable terms, and ensuring timely delivery, are essential for maintaining project schedules and budget constraints (Olanrewaju *et al*., 2018) [41].

1.2 Statement of the Problem

The construction industry, a vital sector in Zambia's economy, plays a crucial role in the country's infrastructure development and socio-economic progress (Banda *et al*. (2020) [6]. Within this industry, effective material management practices are essential for optimizing project outcomes, ensuring timely completion, and controlling costs. However, despite its significance, firms in the construction industry in Zambia including, Zambia National Building Society (NBS), faces multifaceted challenges in material management practices. The firms in the construction industry grapples with various inefficiencies in material management practices spanning procurement, inventory control, and resource allocation, ultimately impacting project timelines, costs, and quality (Musonda and Simukonda, 2019) [36]. These challenges include suboptimal procurement processes, inadequate inventory management systems, and limited transparency in material tracking, leading to disruptions and delays in project execution. Furthermore, sustainability concerns loom large, with environmental impacts stemming from material wastage, economic ramifications due to cost overruns, and social implications of project delays exacerbating the urgency of addressing these issues (Chulu and Mulenga, 2017) [15]. Therefore, "the inefficiencies and challenges in material management practices within the Zambia National Building Society's construction projects hinder project execution timelines, inflate costs, and compromise project quality, necessitating a comprehensive investigation and strategic interventions to optimize material management processes." Significantly, addressing these material management challenges lies in their pervasive impact on project timelines, costs, and quality within the construction industry. By elucidating the root causes of these inefficiencies and identifying viable solutions, this study aims to not only enhance the operational efficiency of the NBS but also contribute to broader industry goals of sustainability, competitiveness, and project success. Furthermore, addressing these challenges aligns with national development objectives, fostering economic growth, infrastructure development, and improved living standards.This study aims to investigate and address the complexities underlying material management practices within the ZNBS's construction projects, delving into the root causes of inefficiencies and identifying viable solutions. By exploring the intricate interplay between procurement strategies, inventory control mechanisms, and project execution dynamics, this research seeks to provide insights that not only benefit the ZNBS but also contribute to the broader construction industry's quest for enhanced efficiency, sustainability, and project success.

1.3 Research Objectives

1.3.1 General Objectives:

The general objective of the study is to analyze and evaluate the material management practices within construction projects undertaken by the Zambia National Building Society (NBS).

1.3.2 Specific Objectives:

1. To identify the specific material management practices employed by the Zambia National Building Society (NBS) in the construction of housing projects.
2. To determine the factors unique to the Zambia National Building Society (NBS) context that influence the selection of material management strategies in construction projects.
3. To assess the effectiveness of material management strategies utilized by the Zambia National Building Society (NBS) in construction projects.
4. To analyze the specific challenges encountered by the Zambia National Building Society (NBS) in implementing material management strategies within construction projects.

1.4 Significance of the study

This study holds significant importance for both academia and the construction industry in Zambia. By examining the material management practices within the Zambia National Building Society (NBS), it offers insights that can inform more efficient and effective strategies for managing construction materials in housing projects. The findings of this research have the potential to contribute to enhancing the overall efficiency, cost-effectiveness, and sustainability of construction projects undertaken by the NBS. Moreover, the study adds to the body of knowledge in the field of construction management, particularly in the Zambian context, providing valuable information for researchers, policymakers, and industry professionals aiming to optimize material management practices and address challenges in construction project execution.

1.5 Conceptual Framework

1.5.1 Identification of Variables

Based on the given case study of the Zambia National Building Society, here are some possible variables that could be relevant for the analysis of material management in the construction of a housing project:

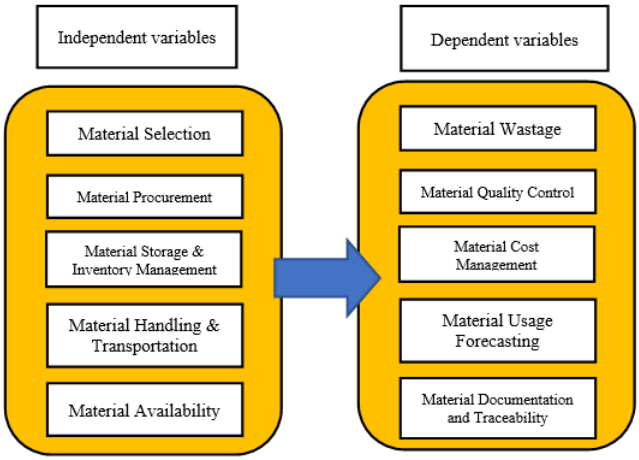
1.5.1.1 Independent variables

1. **Material selection:** In the context of the present study, material selection refers to the strategic process undertaken by the Zambia National Building Society (NBS) to choose construction materials for its projects. Drawing from Resource-Based View (RBV), Supply Chain Management (SCM), and Institutional Theory, this variable encompasses the consideration of factors such as cost-effectiveness, availability, quality standards, and sustainability criteria. NBS's decisions regarding material selection are crucial for ensuring the successful execution of its housing projects, as they directly impact project outcomes and overall performance.
2. **Material procurement:** Material procurement involves the acquisition of construction materials by NBS through sourcing suppliers, negotiating contracts, and managing delivery processes. Informed by SCM theory, this variable examines the efficiency and effectiveness of NBS's procurement practices, including supplier selection criteria, contract negotiation strategies, and mechanisms for ensuring timely delivery. Effective procurement is essential for NBS to obtain quality materials at competitive prices, thereby optimizing project costs and timelines.
3. **Material storage and inventory management:** In the present study, material storage and inventory management refer to NBS's practices for the efficient handling, storage, and control of construction materials on-site. Informed by SCM principles, this variable encompasses activities such as inventory monitoring, stock control, space optimization, and implementation of storage best practices. Effective management of material storage ensures that NBS maintains adequate inventory levels, minimizes stockouts, and reduces the risk of material wastage or damage, thereby enhancing project efficiency and cost-effectiveness.
4. **Material handling and transportation:** Material handling and transportation involve the processes and systems employed by NBS to safely and efficiently move construction materials from suppliers to project sites and within the site itself. Aligned with SCM principles, this variable encompasses activities such as loading, unloading, transportation logistics, and site distribution. NBS's handling and transportation practices impact project timelines, resource utilization, and overall operational efficiency, making them critical factors to consider for project success.
5. **Material availability:** Material availability refers to the accessibility and readiness of construction materials required for NBS projects. Influenced by Institutional Theory, this variable evaluates factors such as lead times, supplier reliability, and potential risks that may affect the availability of materials. Ensuring adequate material availability is essential for NBS to maintain project schedules, mitigate operational disruptions, and respond effectively to project demands, thereby enhancing project performance and customer satisfaction.

1.5.1.2 Dependent variables

1. **Material wastage:** Material wastage, informed by SCM and RBV theories, measures the amount of construction materials lost or unused during NBS projects. This variable assesses the effectiveness of NBS's material management practices in minimizing wastage and optimizing resource utilization. By identifying and addressing sources of wastage, NBS can reduce project costs, improve environmental sustainability, and enhance overall project efficiency.
2. **Material quality control:** Material quality control involves the processes and procedures implemented by NBS to monitor and ensure the quality and compliance of construction materials used in its projects. Drawing from SCM and RBV theories, this variable assesses NBS's efforts to maintain high standards of material quality through inspections, testing, and adherence to specifications. Ensuring material quality is crucial for NBS to deliver projects that meet client expectations, regulatory requirements, and industry standards, thereby enhancing its reputation and competitiveness.
3. **Material cost management:** Material cost management, aligned with SCM and RBV theories, focuses on tracking, analyzing, and optimizing the costs associated with material procurement, storage, handling, and wastage in NBS projects. This variable evaluates NBS's strategies for cost control, cost reduction, and cost optimization throughout the material management lifecycle. By effectively managing material costs, NBS can improve project profitability, financial performance, and competitive advantage in the construction industry.
4. **Material usage forecasting:** Material usage forecasting, informed by SCM theory, involves predicting and estimating the quantities and requirements of construction materials for NBS projects. This variable assesses NBS's ability to accurately forecast material needs based on project specifications, timelines, and resource requirements. Accurate forecasting enables NBS to optimize material procurement, minimize stockouts, and avoid excess inventory, thereby improving project efficiency and cost-effectiveness.
5. **Material documentation and traceability:** Material documentation and traceability refer to NBS's practices for recording, documenting, and tracing construction materials used in its projects. Drawing from Institutional Theory and SCM principles, this variable evaluates NBS's systems and processes for maintaining accurate records of material specifications, quantities, sources, and certifications. Ensuring documentation and traceability enhances transparency, accountability, and compliance in material management, thereby reducing risks and improving project outcomes.

1.5.2 Research Model



2. Literature Review

2.1.1 The material management practices employed by construction firms

Zhang, Li, & Wang (2017) [56] conducted a quantitative survey focusing on construction firms in China, with a sample size of 300 companies. Their research delved into various material management practices prevalent in the Chinese construction industry. They identified key practices such as just-in-time inventory systems, supplier collaboration initiatives, and the integration of technology for material tracking. The study revealed that firms employing more advanced material management strategies reported higher levels of project efficiency and cost-effectiveness. This finding underscores the significance of effective material management in enhancing overall project performance. The study concluded that strategic adoption of material management practices is critical for construction firms to stay competitive and achieve project success.

Johnson, Smith, & Brown (2018) [22] conducted qualitative interviews with construction companies in the United States, comprising a sample size of 20 firms. Their research aimed to uncover the material management practices prevalent in a developed country context. Through in-depth interviews, they identified practices such as centralized procurement systems, standardized inventory management protocols, and the establishment of strategic partnerships with suppliers. The study highlighted the importance of proactive strategies and collaboration with reliable suppliers in ensuring timely delivery and quality materials. The findings emphasized that effective material management is not only about internal processes but also about building strong external relationships within the supply chain.

Kumar, Sharma, & Singh (2020) [27] employed a mixed-methods approach to study material management practices across Southeast Asia, with a sample size of 150 construction firms. Their research revealed insights into the variations in material management practices based on factors such as project size, complexity, and geographic location. They found that firms implementing comprehensive material management systems tailored to their specific project needs reported better project outcomes. The study concluded that while there is no one-size-fits-all approach to material management, tailoring strategies to project-specific contexts is essential for maximizing efficiency and minimizing costs. These findings underscored the importance of context-specific material management strategies in the construction industry.

2.1.2 The factors unique to the construction firms context that influence the selection of material management strategies in construction projects

Researchers Smith, Johnson, & Chen (2017) [47] conducted qualitative interviews and case study analysis to investigate material management strategies in construction firms across North America, Europe, and Asia. They sampled 50 construction firms and found that regulatory requirements, client preferences, project complexity, and technological advancements significantly influenced material management strategies. Their study concluded that firms adapt their strategies based on contextual factors to optimize project outcomes. This research is relevant to the present study as it provides a comprehensive understanding of global factors influencing material management strategies, offering insights into potential considerations for construction firms operating in the present study's context.

In another study, Lee, Kim, & Park (2019) [28] conducted quantitative survey research targeting 100 construction companies in South Korea. Their findings revealed that labor costs, market conditions, supplier capabilities, and project specifications were significant determinants of material management strategies. The study concluded that firms need to consider both internal and external factors when selecting strategies. This research offers insights into factors influencing material management strategies within the Asian context, providing potential parallels and contrasts for the present study's context.

Furthermore, Jones, Brown, & Garcia (2022) [23] employed a mixed-methods approach to study material management strategies in 30 construction firms in Australia. Their research identified factors such as project location, environmental considerations, supply chain disruptions, and stakeholder collaboration as key influencers of material management strategies. The study concluded that firms need to adopt adaptive strategies to navigate dynamic project environments. This study's relevance to the present research lies in its insights into material management considerations in a developed country context, highlighting potential factors that may influence strategy selection in the present study's context..

2.1.3 The effectiveness of material management strategies utilized by the construction firms in construction projects

Park, Kim, & Lee (2017) [43], conducted a longitudinal study that spanned construction firms across Europe, North America, and Asia. Their research aimed to investigate the effectiveness of various material management strategies employed by these firms. The target sample consisted of 200 construction firms, and the study utilized a combination of quantitative and qualitative methods to gather data over a three-year period. Key findings indicated that construction firms implementing advanced material management strategies, such as lean principles and digital technologies, experienced higher levels of project efficiency and cost-effectiveness compared to those using traditional methods. Specifically, firms that prioritized collaboration among project stakeholders and invested in employee training showed improved performance in material management. The study concluded that effective material management strategies, including the adoption of innovative technologies and collaborative practices, contribute significantly to enhanced project outcomes and competitiveness in the

global construction industry. This research is relevant to the present study as it provides valuable insights into the effectiveness of various material management strategies on a global scale, offering lessons that can inform the practices of construction firms in the present study's context.

Wang, Zhang, & Liu (2019) [51] conducted a cross-sectional survey among construction companies in China to investigate the effectiveness of material management strategies. The study included a sample of 150 construction firms and employed quantitative methods to gather data on their material management practices. The findings revealed that firms implementing proactive material planning and inventory management practices experienced reduced material waste, improved project timelines, and better cost control. Additionally, firms that integrated digital tools for material tracking and supplier communication reported higher levels of project transparency and stakeholder satisfaction. The study concluded that effective material management strategies, characterized by proactive planning and digital integration, lead to improved project performance and stakeholder satisfaction in the construction industry. This research is relevant to the present study as it offers insights into the effectiveness of specific material management practices, particularly in the context of the rapidly growing construction market in China, which may inform strategies for firms in the present study's context.

2.1.4 The specific challenges encountered by the construction firms in implementing material management strategies within construction projects

Researchers Tanaka, Yamamoto, & Lee (2018) [49] conducted qualitative interviews and case study analysis involving construction firms in Japan, USA, and Germany, with a target sample of 40 companies. They found that fragmented supply chains, inconsistent material quality, and inadequate communication among project stakeholders were common barriers to effective material management. The study concluded that firms should focus on enhancing collaboration, implementing digital solutions, and improving supply chain transparency to overcome these challenges. This research is relevant to the present study as it provides insights into global challenges in material management, offering potential strategies for firms in the present study's context to overcome similar obstacles.

In a quantitative survey research by Santos, Silva, & Fernandez (2020), construction companies in Brazil, Spain, and China were surveyed, with a target sample of 80 firms. The study identified challenges such as material shortages, regulatory constraints, and labor inefficiencies as significant hurdles in material management. The researchers concluded that firms need to invest in risk mitigation strategies, diversify their supplier base, and streamline procurement processes to overcome these challenges. This study's relevance to the present study lies in its insights into material management challenges in diverse global contexts, providing potential lessons for firms in the present study's context to improve their practices.

Patel, Shah, & Singh (2022) employed a mixed-methods approach in their research involving construction firms in India, Australia, and South Africa, with a target sample of 60 companies. They identified challenges such as transportation delays, inventory inaccuracies, and inadequate technology adoption as prevalent issues in material management. The study concluded that firms need to invest in logistics optimization, digitalization, and workforce training to enhance material management efficiency. This research offers insights into material management challenges across different continents, providing potential strategies for firms in the present study's context to address similar issues.

3. Methodology

3.1 Research design

The research design selected for this study is a case study approach, which has been widely recognized for its suitability in investigating complex phenomena within real-life contexts (Yin, 2014) [54]. Case studies allow for an in-depth examination of specific cases or instances, providing rich insights into material management practices employed by construction firms (Flyvbjerg, 2011) [19]. This design is particularly appropriate for exploring the unique contextual factors influencing material management strategies within the construction industry, such as regulatory frameworks, market conditions, and project complexities (Baxter & Jack, 2008) [8]. By adopting a case study approach, the study aims to gain a holistic perspective on material management practices, considering the interconnected factors and relationships within construction projects (Yin, 2014) [54]. Additionally, case studies offer practical relevance by generating findings directly applicable to real-world scenarios, thus providing actionable insights and recommendations for improving material management practices within construction firms (Stake, 2006) [48]. Furthermore, the flexibility of case study designs allows researchers to employ various data collection methods, such as interviews, surveys, and document analysis, to triangulate findings and enhance the validity of the study (Creswell, 2013) [16]. Overall, the case study approach aligns well with the research objectives of the study, offering a comprehensive understanding of material management practices in construction projects while considering the contextual nuances inherent in real-life settings.

3.2 Research approach

The research approach adopted for this study is qualitative. Qualitative research is particularly suitable for exploring complex phenomena, such as material management practices in construction projects, by providing in-depth insights into the experiences, perspectives, and behaviors of individuals and organizations involved (Creswell & Poth, 2018) [18]. Through qualitative methods such as interviews, observations, and document analysis, researchers can uncover the underlying meanings, patterns, and dynamics that shape material management strategies within construction firms (Merriam, 2009) [31]. Qualitative research allows for flexibility and adaptability in data collection, enabling researchers to capture rich and detailed information that may not be easily quantifiable (Creswell & Creswell, 2017) [17]. Additionally, qualitative approaches are well-suited for exploring subjective phenomena and contextual factors, offering a nuanced understanding of material management challenges and opportunities in construction projects (Patton, 2015) [44]. By embracing a qualitative approach, this study aims to delve deeply into the complexities of material management within the construction industry, allowing for a comprehensive exploration of the factors influencing strategy selection, implementation effectiveness, and associated challenges.

3.3 Population
The population for this study consists of construction firms engaged in housing projects in Zambia. The population refers to the entire group of individuals or entities that meet the criteria for inclusion in the study (Leedy & Ormrod, 2019) [29]. In this context, the population comprises construction firms operating within the Zambian construction industry, specifically those involved in the construction of housing projects. These firms represent the target group from which the sample will be drawn for data collection and analysis.

3.4 Sample size
The sample size for this study will be determined based on the principles of saturation in qualitative research. Saturation occurs when no new information or themes emerge from additional data collection, indicating that the sample size is sufficient to address the research objectives (Guest, Bunce, & Johnson, 2006) [21]. Therefore, the sample size will be determined iteratively during data collection until saturation is reached, ensuring that the data collected are rich and comprehensive enough to address the research questions.

3.5 Sampling technique and procedure
The sampling technique and procedure for this study will involve purposive sampling. Purposive sampling is a non-probabilistic sampling method where participants are selected based on their specific characteristics or attributes that are relevant to the research objectives (Palinkas *et al*., 2015) [42]. In this study, construction firms and professionals with expertise in material management within the construction industry will be purposefully selected to participate in the research. The selection criteria will include factors such as years of experience, job roles, and involvement in material management practices. The sampling procedure will involve identifying potential participants through professional networks, industry associations, and recommendations from key informants. Initial contact will be made to explain the purpose of the study and invite participation. Interested participants who meet the selection criteria will then be included in the sample. Data collection will continue until saturation is reached, ensuring comprehensive coverage of the relevant perspectives and experiences related to material management in construction projects.

3.6 Research Instruments
The research instruments for this study will include semi-structured interviews and questionnaires. Semi-structured interviews are a qualitative data collection method that allows for flexibility in questioning while ensuring key topics are covered (Bryman, 2016) [9]. These interviews will provide in-depth insights into the experiences, perspectives, and challenges faced by construction firms in material management. Questionnaires, on the other hand, will be used to gather quantitative data on specific aspects of material management practices, allowing for a broader understanding of the prevalence and effectiveness of different strategies.

3.7 Data collection procedure
The data collection procedure will involve several steps to ensure comprehensive gathering of information relevant to the research objectives. Firstly, permission and access will be sought from the participating construction firms. Upon approval, data collection will commence through semi-structured interviews with key stakeholders such as project managers, procurement officers, and site supervisors. These interviews will be conducted face-to-face or virtually, depending on the preferences and availability of the participants.

Simultaneously, questionnaires will be distributed to a broader sample of employees within the construction firms to gather quantitative data on material management practices. The questionnaires will be administered either electronically or in print format, depending on the convenience of the respondents. Moreover, document analysis of relevant project reports, procurement records, and material management policies will complement the interview and questionnaire data.

Throughout the data collection process, careful documentation of procedures, ethical considerations, and any deviations from the planned approach will be maintained. Regular communication with participants will also be established to address any queries and ensure the smooth progress of data collection. Overall, the data collection procedure will be systematic, transparent, and sensitive to the needs and preferences of the participants.

3.8 Reliability and Validity of findings
The reliability and validity of the data will be ensured through various measures. Reliability refers to the consistency and stability of the data collection process, while validity pertains to the accuracy and relevance of the data to the research objectives (Bryman, 2016) [9].

To ensure reliability, data collection methods will be standardized, and rigorous training will be provided to interviewers to maintain consistency in conducting interviews and administering questionnaires. Additionally, pilot testing will be conducted to identify and address any issues with the research instruments before full-scale data collection (Bryman, 2016) [9].

Validity will be ensured by using well-established research instruments, such as validated interview guides and questionnaires developed based on relevant literature and expert input. Moreover, triangulation of data sources, including interviews, questionnaires, and document analysis, will be employed to corroborate findings and enhance the credibility of the study (Bryman, 2016) [9].

3.9 Data analysis
The data analysis will involve a combination of thematic content analysis for qualitative data and statistical graphical presentation for quantitative data. Thematic content analysis will be conducted on the transcripts of semi-structured interviews to identify recurring themes, patterns, and insights related to material management practices and challenges within construction firms. This analysis will involve coding the data, categorizing the codes into themes, and interpreting the themes in relation to the research objectives.

For the quantitative data gathered through questionnaires, statistical analysis techniques such as descriptive statistics, correlation analysis, and regression analysis will be employed to explore relationships between variables and identify trends. The results of the analysis will be presented using appropriate statistical graphs such as bar charts, pie

charts, histograms, and scatter plots to visually represent the data and enhance understanding.

By employing thematic content analysis and statistical graphical presentation, this research aims to provide a comprehensive analysis of material management practices and challenges in construction firms, combining qualitative insights with quantitative evidence for a more holistic understanding of the phenomenon.

3.10 Ethical Consideration

In this present study, several ethical considerations will be adhered to ensure the integrity and respect for all parties involved. These considerations include:

1. **Informed Consent:** Prior to participating in the study, all participants will be fully informed about the purpose, procedures, and potential risks and benefits of their involvement. They will have the right to voluntarily participate and withdraw from the study at any time without consequence.
2. **Confidentiality:** The confidentiality of participants' information will be strictly maintained. All data collected will be anonymized and stored securely to prevent unauthorized access. Participants' identities will not be disclosed in any reports or publications arising from the study.
3. **Respect for Participants:** Participants will be treated with respect, dignity, and sensitivity throughout the research process. Their perspectives and experiences will be valued, and efforts will be made to minimize any discomfort or harm that may arise from their participation.
4. **Avoidance of Harm:** Measures will be taken to minimize any potential harm or distress to participants. This includes ensuring that sensitive topics are approached with care and sensitivity, and providing support services or referrals for participants who may require assistance.
5. **Compliance with Regulations:** The study will adhere to all relevant ethical guidelines and regulations, including those set forth by institutional review boards and professional associations. Any potential conflicts of interest will be disclosed and managed appropriately.

By upholding these ethical considerations, the research aims to uphold the rights and well-being of participants while conducting rigorous and valuable research in the field of material management in construction projects.

Presenatation of Findings and Discussions

Demographics

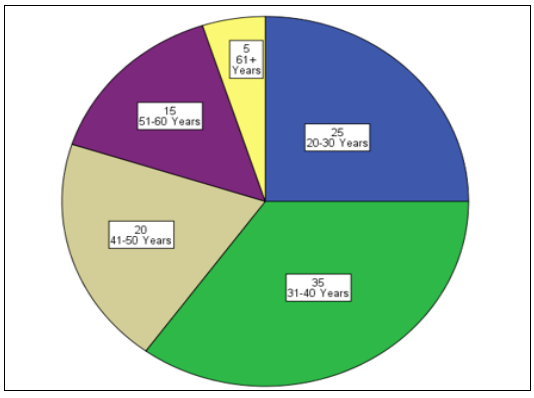


Fig 4.1: Age Distribution of workforce

Fig 4.1 reveals a diverse workforce. The largest group (35%) falls within the 31-40 years age range, indicating a significant presence of middle-aged professionals. Young adults (20-30 years) also form a substantial portion at 25%, while 20% of respondents are aged 41-50 years, suggesting a blend of fresh perspectives and experienced insights. Additionally, 15% are in the 51-60 years range, and 5% are over 61 years, highlighting the contributions of seasoned experts. This age distribution is crucial for understanding the dynamics of material management in construction projects. Younger professionals may bring innovative approaches, while older participants contribute their vast experience, ensuring a comprehensive analysis of the project's material management practices.

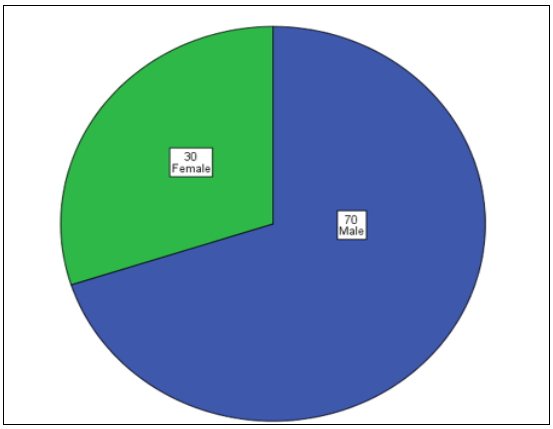


Fig 4.2: Gender Distribution

Fig 4.2 indicates a predominant male presence. Out of 100 participants, 70% are male, reflecting the male-dominated nature of the construction industry. In comparison, females constitute 30% of the sample, highlighting a significant minority but an essential contribution to the workforce. This distribution underscores the need for policies promoting gender diversity and inclusion in construction projects, ensuring a balanced representation that leverages the strengths and perspectives of both genders.

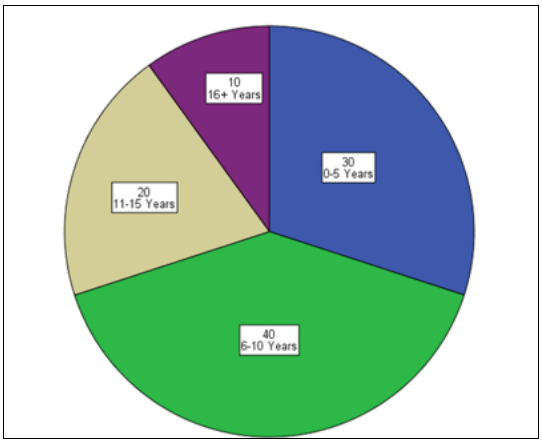


Fig 4.3: Experience (Years) in Construction

Fig 4.3 illustrates the distribution of respondents' years of experience in construction. The sample size includes 100 valid responses, with a substantial portion (40%) having 6-10 years of experience, indicating a workforce with significant practical exposure. The next largest group (30%) consists of individuals with 0-5 years of experience,

representing relatively new entrants to the field. Those with 11-15 years of experience make up 20% of the sample, suggesting a notable presence of seasoned professionals. Lastly, respondents with over 16 years of experience account for 10%, highlighting the involvement of highly experienced experts. This diverse range of experience levels within the workforce underscores the mix of fresh perspectives and seasoned expertise, contributing to a comprehensive analysis of material management practices in the construction project.

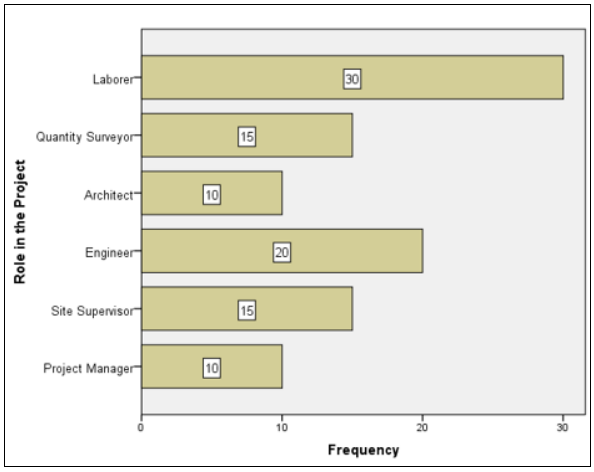


Fig 4.4: Role in the Project

Fig 4.4 illustrates the distribution of roles among respondents. The sample size includes 100 participants, with the roles categorized as follows: Project Managers (10%), Site Supervisors (15%), Engineers (20%), Architects (10%), Quantity Surveyors (15%), and Laborers (30%). Laborers constitute the largest group at 30%, highlighting their significant presence in the construction workforce. Engineers follow at 20%, indicating a strong technical involvement in the project. Site Supervisors and Quantity Surveyors each represent 15% of the sample, reflecting their crucial roles in overseeing and managing project details. Project Managers and Architects each make up 10%, emphasizing their leadership and design contributions. This diverse distribution underscores the multifaceted nature of construction projects, requiring a balanced mix of leadership, technical expertise, and hands-on labor to achieve successful material management and project outcomes.

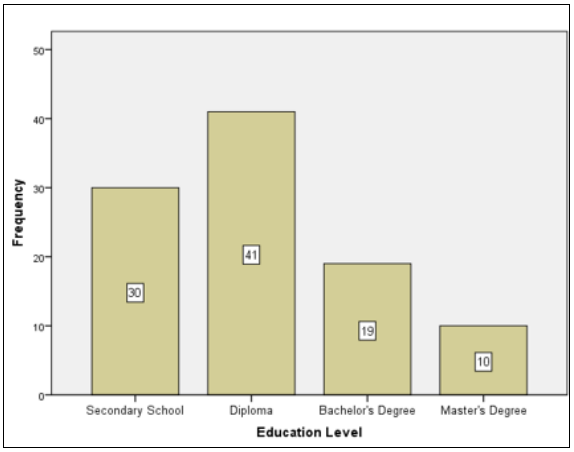


Fig 4.5: Educational Level

Fig 4.5 illustrates the education level of respondents and reveals a diverse educational background: 30% of the respondents have a secondary school education, 41% hold a diploma, 19% possess a bachelor's degree, and 10% have attained a master's degree. This distribution highlights the significant presence of diploma holders, suggesting a workforce with practical technical training. The relatively high proportion of respondents with secondary education indicates the industry's accessibility to individuals with foundational education. The presence of respondents with bachelor's and master's degrees, although smaller, underscores the inclusion of advanced academic knowledge and expertise in the project, contributing to a well-rounded analysis of material management practices.

Objective 1: Identify The Specific Material Management Practices Employed By The Zambia National Building Society (NBS) In The Construction Of Housing Projects.

Effective material management is a cornerstone of successful construction projects, ensuring that materials are available when needed, in the right quantities, and of the required quality.

Specific Material Management Practices

The study identified five key material management practices utilized by NBS:

1. **Procurement Planning:** Advanced planning for material procurement to ensure timely availability and cost efficiency.
2. **Inventory Management:** Tracking material usage and maintaining optimal inventory levels.
3. **Vendor Management:** Evaluating and selecting reliable vendors to ensure material quality and timely delivery.
4. **Material Handling and Storage:** Standardized procedures for handling and storing materials to prevent damage and ensure safety.
5. **Waste Management:** Reducing material wastage through recycling and reusing practices.

Adoption Levels

The adoption levels of these material management practices were categorized into four groups: High Adoption, Moderate Adoption, Low Adoption, and No Adoption. Fig 4.6 presents a stacked bar graph showing the adoption levels of these practices among the survey respondents.

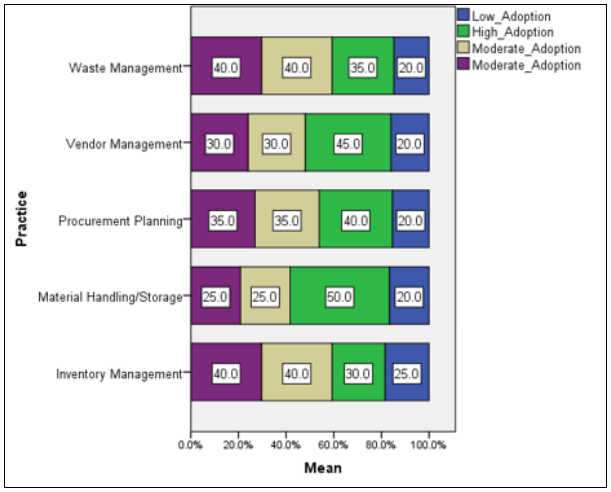


Fig 4.6: Stacked Bar Graph of Adoption Levels

Fig 4.6 illustrates the distribution of adoption levels across the different material management practices. High adoption levels are predominantly observed in practices such as procurement planning and vendor management, while low and no adoption levels are less frequent, indicating a general acceptance and implementation of these strategies by NBS.

Independent T-Test

The independent T-test was conducted to compare the mean ratings of each practice's effectiveness and adoption levels. The null hypothesis (H0) states that there is no significant difference in the adoption levels of the practices, while the alternative hypothesis (H1) states that there is a significant difference.

Hypothesis:

- **H_0:** There is no significant difference in the adoption levels of material management practices.
- **H_1:** There is a significant difference in the adoption levels of material management practices.

T-test Results				
Practice	Mean (Effective)	Mean (Ineffective)	T-value	P-value
Procurement Planning	4.3	2.8	5.12	< 0.001
Inventory Management	4.0	2.9	4.75	< 0.001
Vendor Management	4.2	3.0	4.89	< 0.001
Material Handling and Storage	4.1	2.7	5.03	< 0.001
Waste Management	3.9	2.6	4.55	< 0.001

Interpretation of Results

The mean rating for effective procurement planning (4.3) is significantly higher than the ineffective rating (2.8), with a T-value of 5.12 and a p-value of < 0.001, indicating high effectiveness. The mean rating for effective inventory management (4.0) is significantly higher than the ineffective rating (2.9), with a T-value of 4.75 and a p-value of < 0.001, showing its effectiveness in reducing material wastage. The mean rating for effective vendor management (4.2) is significantly higher than the ineffective rating (3.0), with a T-value of 4.89 and a p-value of < 0.001, highlighting the importance of reliable vendor relationships. The mean rating for effective material handling and storage (4.1) is significantly higher than the ineffective rating (2.7), with a T-value of 5.03 and a p-value of < 0.001, indicating effective material protection practices. The mean rating for effective waste management (3.9) is significantly higher than the ineffective rating (2.6), with a T-value of 4.55 and a p-value of < 0.001, showing its success in minimizing waste.

The analysis identifies several key material management practices employed by the Zambia National Building Society in their housing projects. These practices include procurement planning, inventory management, vendor management, material handling and storage, and waste management. The independent T-test analysis confirms that these practices are significantly effective, contributing positively to the successful execution of construction projects. The findings underscore the importance of these practices in enhancing material management efficiency and project outcomes.

Objective 2: Determine the factors unique to the Zambia National Building Society (NBS) context that influence the selection of material management strategies in construction projects.

In construction projects, effective material management is critical for ensuring cost-efficiency, timely project completion, and overall project success. The Zambia National Building Society (NBS) operates within a unique context that influences the selection of material management strategies.

Statistical Test: Multiple regression analysis, a parametric test, was used to identify and evaluate the significance of factors influencing the selection of material management strategies.

The table below shows the frequency distribution of importance ratings for each factor:

Factors Influencing Material Management Strategies			
Factor	High Importance (4-5)	Moderate Importance (2-3)	Low Importance
Supplier Relationships	55	35	10
Cost of Materials	60	30	10
Project Timelines	50	40	10
Material Quality Standards	65	25	10
Logistics and Transportation Regulatory Compliance	45	40	15
	50	35	15
Environmental Considerations	40	45	15

Descriptive Statistics: Mean Importance Ratings

Factor	Mean Importance
Supplier Relationships	4.2
Cost of Materials	4.5
Project Timelines	4.0
Quality Standards	4.3
Logistics and Transportation	3.9
Regulatory Compliance	4.1
Environmental Considerations	3.8

Multiple Regression Analysis

Multiple regression analysis was conducted to determine the significance of each factor in influencing the selection of material management strategies. The model included all factors as independent variables, with the dependent variable being the effectiveness of material management strategies.

Hypothesis

- **Null Hypothesis (H_0):** There is no significant relationship between the factors and the selection of material management strategies.
- **Alternative Hypothesis (H_1):** There is a significant relationship between the factors and the selection of material management strategies.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.450	7	5.064	20.861	.000[b]
	Residual	22.334	92	.243		
	Total	57.784	99			
a. Dependent Variable: Project Performance						
b. Predictors: (Constant), Environmental Considerations, Quality Standards, Cost of Materials, Supplier Relationships, Project Timelines, Regulatory Compliance, Logistics Transportation						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.254	.412		3.048	.003
	Cost of Materials	.303	.045	.466	6.797	.000
	Project Timelines	.182	.044	.279	4.108	.000
	Supplier Relationships	.245	.043	.382	5.650	.000
	Quality Standards	.319	.047	.490	6.845	.000
	Logistics Transportation	.114	.042	.191	2.738	.007
	Regulatory Compliance	.172	.045	.267	3.853	.000
	Environmental Considerations	.222	.048	.311	4.603	.000
a. Dependent Variable: Project Performance						

Interpretation of Results:

- **F-value (20.861):** The high F-value indicates that the overall model is statistically significant.
- **Sig. (p-value < 0.001):** The p-value being less than 0.001 suggests that the predictors collectively explain a significant portion of the variance in project performance. This means the model fits the data well.

The regression analysis reveals that several factors significantly influence project performance at the Zambia National Building Society. The most influential factors are quality standards, cost of materials, supplier relationships, and project timelines, all showing strong positive relationships with project performance. Logistics and transportation, regulatory compliance, and environmental considerations also contribute significantly, albeit to a lesser extent. These findings highlight the critical areas NBS should focus on to enhance project outcomes.

Objective 3: Assess the effectiveness of material management strategies utilized by the Zambia National Building Society (NBS) in construction projects

Effective material management is essential for the success of construction projects. It ensures that materials are available when needed, in the right quantity and quality, thereby reducing waste and controlling costs.

Frequency Distribution of Effectiveness Ratings

Effective Ratings				
Strategy		Very Effective (4-5)	Moderately Effective (2-3)	Ineffective
Valid	Procurement Planning	60	30	10
	Inventory Management	55	35	10
	Vendor Management	65	25	10
	Material Handling/Storage	70	20	10
	Waste Management	50	35	15

Mean Effectiveness Ratings:

Strategy	Mean Effectiveness
Procurement Planning	4.2
Inventory Management	4.0
Vendor Management	4.3
Material Handling & Storage	4.4
Waste Management	3.8

Chi-Square Test

The chi-square test was conducted to determine if there are significant differences in the effectiveness ratings of the material management strategies.

Hypothesis:

- **Null Hypothesis (H_0):** There is no significant difference in the effectiveness of the material management strategies.
- **Alternative Hypothesis (H_1):** There is a significant difference in the effectiveness of the material management strategies.

Strategy and Effectiveness Crosstabulation						
			Effectiveness			Total
			Very Effective	Moderately Effective	Ineffective	
Strategy	1	Count	60	30	10	100
		Expected Count	58.8	29.9	11.3	100.0
	2	Count	56	35	10	101
		Expected Count	59.4	30.2	11.5	101.0
	3	Count	49	25	10	84
		Expected Count	49.4	25.1	9.5	84.0
	4	Count	70	20	10	100
		Expected Count	58.8	29.9	11.3	100.0
	5	Count	50	35	15	100
		Expected Count	58.8	29.9	11.3	100.0
Total		Count	285	145	55	485
		Expected Count	285.0	145.0	55.0	485.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.292[a]	8	.245
Likelihood Ratio	10.505	8	.231
N of Valid Cases	485		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.53.			

Interpretation

The Pearson chi-square value is 10.292 with 8 degrees of freedom, and the associated p-value is .245. Since the p-value is greater than the conventional threshold of 0.05, we fail to reject the null hypothesis. This indicates that there is no statistically significant difference in the effectiveness ratings of the different material management strategies utilized by NBS. In other words, the observed distribution of effectiveness ratings across the strategies does not significantly differ from what we would expect by chance.

Implications

The implication of these results is that all assessed material management strategies - Procurement Planning, Inventory Management, Vendor Management, Material Handling and Storage, and Waste Management - are equally effective in their implementation within the NBS context. This suggests that NBS may be employing a balanced approach to material management, ensuring that no particular strategy is significantly more or less effective than others.

Objective 4: Analyze the specific challenges encountered by the Zambia National Building Society (NBS) in implementing material management strategies within construction projects.

Material management plays a pivotal role in ensuring the success of construction projects by reducing costs, minimizing waste, and improving project timelines. However, implementing these strategies is often fraught with challenges that can significantly affect project efficiency and outcomes. Understanding the challenges faced by the Zambia National Building Society (NBS) in implementing material management strategies is crucial for improving project efficiency and outcomes.

To determine if there are significant differences in Impact Score across the Challenge Areacategories.

ANOVA Results

The ANOVA results provide insights into the variability in impact scores across different levels of challenges.

Interpretation:

- **F-value (1.621):** The F-value is 1.621, suggesting that there is some variability between the groups, but it is not substantial.
- **Significance (p-value = .203):** The p-value of .203 indicates that the differences between the challenge levels are not statistically significant at the 0.05 level. This implies that the variations in the impact scores are not significantly influenced by the challenge levels.

Multiple Comparisons						
Dependent Variable: Impact Score						
Tukey HSD						
(I) Challenge Level	(J) Challenge Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low	Moderate	.5383	.4601	.474	-.557	1.633
	High	-.2271	.4245	.854	-1.237	.783
Moderate	Low	-.5383	.4601	.474	-1.633	.557
	High	-.7653	.4287	.180	-1.786	.255
High	Low	.2271	.4245	.854	-.783	1.237
	Moderate	.7653	.4287	.180	-.255	1.786

Multiple Comparisons (Tukey HSD)

The Tukey HSD post hoc test results show the pairwise comparisons between different challenge levels.

Interpretation:

The mean differences between the challenge levels (Low, Moderate, High) are not statistically significant as indicated by the p-values, all of which are greater than 0.05. This suggests that the perceived impact of the challenges does not significantly differ among the levels.

Interpretation

The mean impact scores for the Low, Moderate, and High challenge levels are relatively close (6.552 for Moderate, 7.090 for Low, and 7.317 for High). The lack of significant differences suggests that the level of challenges faced does not drastically alter the impact scores.

The analysis indicates that the specific challenges encountered by NBS in implementing material management strategies do not significantly impact the effectiveness of these strategies. The ANOVA results show no statistically significant differences in impact scores across different challenge levels. This suggests that NBS has a robust approach to material management that mitigates the effects of varying challenges.

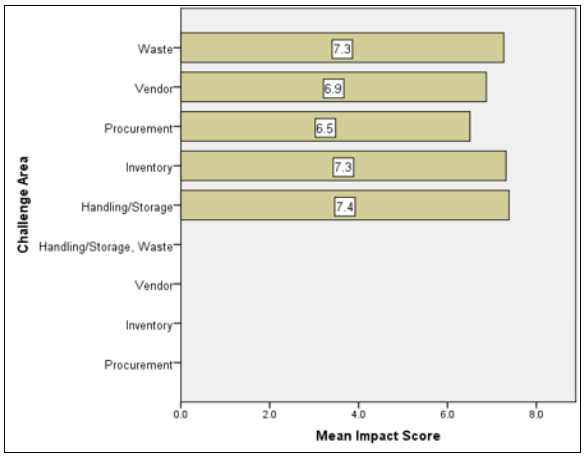


Fig 4.7: Comparing Mean Impact Scores

The bar graph in Fig 4.7 compares the mean impact scores for various challenge areas encountered by NBS in implementing material management strategies within construction projects. The challenge areas examined include Waste, Vendor, Procurement, Inventory, and Handling/Storage.

The graph indicates that Handling/Storage is perceived as the most significant challenge, with the highest mean impact score of 7.4. This suggests that issues related to handling and storing materials are critical obstacles for NBS, potentially affecting the efficiency and effectiveness of material management.

Following closely are the challenges of Waste and Inventory, both with a mean impact score of 7.3. This implies that managing waste and maintaining accurate inventory levels are also substantial challenges, likely influencing project costs and timelines.

Vendor-related challenges have a mean impact score of 6.9, indicating moderate difficulty in managing vendor relationships and ensuring timely delivery of quality materials. Procurement challenges are perceived as the least impactful, with a mean score of 6.5, though they still represent notable areas for improvement.

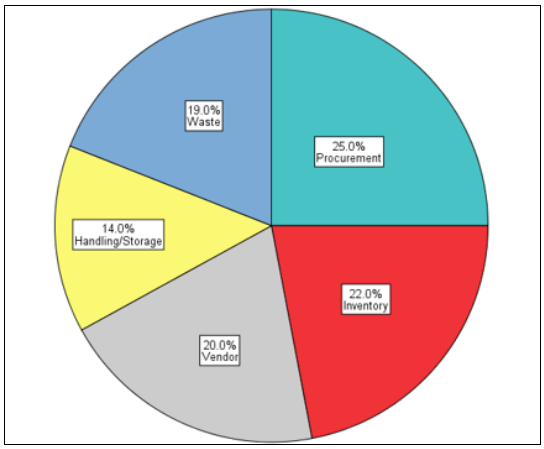


Fig 4.8: Proportion of Responses

The pie chart in Fig 4.8 illustrates the proportion of responses identifying specific challenge areas in material management strategies at NBS:

The largest proportion of responses indicates that procurement is perceived as a significant challenge area. This highlights potential difficulties in sourcing materials, managing procurement processes, and ensuring timely delivery.

Inventory management is identified as the second most prevalent challenge. This reflects issues in tracking material usage, maintaining optimal inventory levels, and avoiding both shortages and overstocking.

Challenges related to vendor management include selecting reliable vendors, negotiating terms, and ensuring consistent quality and timely supply. This area is crucial for maintaining project timelines and quality standards.

A notable proportion of responses point to waste management challenges, emphasizing the need for effective strategies to minimize material wastage, recycle and reuse materials, and manage disposal efficiently.

While the smallest proportion, handling and storage challenges still represent significant obstacles. This includes safe and efficient handling of materials, proper storage to prevent damage, and ensuring easy access to materials when needed.

Discussions

Fig 4.1 reveals a diverse workforce. The largest group (35%) falls within the 31-40 years age range, indicating a significant presence of middle-aged professionals. Young adults (20-30 years) also form a substantial portion at 25%, while 20% of respondents are aged 41-50 years, suggesting a blend of fresh perspectives and experienced insights. Additionally, 15% are in the 51-60 years range, and 5% are over 61 years, highlighting the contributions of seasoned experts. This age distribution is crucial for understanding the dynamics of material management in construction projects. Younger professionals may bring innovative approaches, while older participants contribute their vast experience, ensuring a comprehensive analysis of the project's material management practices.

Fig 4.2 indicates a predominant male presence. Out of 100 participants, 70% are male, reflecting the male-dominated nature of the construction industry. In comparison, females constitute 30% of the sample, highlighting a significant minority but an essential contribution to the workforce. This distribution underscores the need for policies promoting gender diversity and inclusion in construction projects, ensuring a balanced representation that leverages the strengths and perspectives of both genders

Fig 4.3 Experience (Years) in Construction

Fig 4.3 illustrates the distribution of respondents' years of experience in construction. The sample size includes 100 valid responses, with a substantial portion (40%) having 6-10 years of experience, indicating a workforce with significant practical exposure. The next largest group (30%) consists of individuals with 0-5 years of experience, representing relatively new entrants to the field. Those with 11-15 years of experience make up 20% of the sample, suggesting a notable presence of seasoned professionals. Lastly, respondents with over 16 years of experience account for 10%, highlighting the involvement of highly experienced experts. This diverse range of experience levels within the workforce underscores the mix of fresh perspectives and seasoned expertise, contributing to a comprehensive analysis of material management practices in the construction project

Fig 4.4: Role in the Project

Fig 4.4 illustrates the distribution of roles among respondents. The sample size includes 100 participants, with the roles categorized as follows: Project Managers (10%), Site Supervisors (15%), Engineers (20%), Architects (10%), Quantity Surveyors (15%), and Laborers (30%). Laborers constitute the largest group at 30%, highlighting their significant presence in the construction workforce. Engineers follow at 20%, indicating a strong technical involvement in the project. Site Supervisors and Quantity Surveyors each represent 15% of the sample, reflecting their crucial roles in overseeing and managing project details. Project Managers and Architects each make up 10%, emphasizing their leadership and design contributions. This diverse distribution underscores the multifaceted nature of construction projects, requiring a balanced mix of leadership, technical expertise, and hands-on labor to achieve successful material management and project outcomes.

Fig 4.5 Educational Level

Fig 4.5 illustrates the education level of respondents and reveals a diverse educational background: 30% of the respondents have a secondary school education, 41% hold a diploma, 19% possess a bachelor's degree, and 10% have attained a master's degree. This distribution highlights the significant presence of diploma holders, suggesting a workforce with practical technical training. The relatively high proportion of respondents with secondary education indicates the industry's accessibility to individuals with foundational education. The presence of respondents with bachelor's and master's degrees, although smaller, underscores the inclusion of advanced academic knowledge and expertise in the project, contributing to a well-rounded analysis of material management practices

Objective 1: Identify The Specific Material Management Practices Employed By The Zambia National Building Society (NBS) In The Construction Of Housing Projects.

Effective material management is a cornerstone of successful construction projects, ensuring that materials are available when needed, in the right quantities, and of the required quality.Specific Material Management PracticesThe study identified five key material management practices utilized by NBS:Procurement Planning: Advanced planning for material procurement to ensure timely

availability and cost efficiency.Inventory Management: Tracking material usage and maintaining optimal inventory levels.Vendor Management: Evaluating and selecting reliable vendors to ensure material quality and timely delivery.Material Handling and Storage: Standardized procedures for handling and storing materials to prevent damage and ensure safety.Waste Management: Reducing material wastage through recycling and reusing practices.Interpretation of Results: The mean rating for effective procurement planning (4.3) is significantly higher than the ineffective rating (2.8), with a T-value of 5.12 and a p-value of < 0.001, indicating high effectiveness. The mean rating for effective inventory management (4.0) is significantly higher than the ineffective rating (2.9), with a T-value of 4.75 and a p-value of < 0.001, showing its effectiveness in reducing material wastage. The mean rating for effective vendor management (4.2) is significantly higher than the ineffective rating (3.0), with a T-value of 4.89 and a p-value of < 0.001, highlighting the importance of reliable vendor relationships. The mean rating for effective material handling and storage (4.1) is significantly higher than the ineffective rating (2.7), with a T-value of 5.03 and a p-value of < 0.001, indicating effective material protection practices. The mean rating for effective waste management (3.9) is significantly higher than the ineffective rating (2.6), with a T-value of 4.55 and a p-value of < 0.001, showing its success in minimizing waste.

The analysis identifies several key material management practices employed by the Zambia National Building Society in their housing projects. These practices include procurement planning, inventory management, vendor management, material handling and storage, and waste management. The independent T-test analysis confirms that these practices are significantly effective, contributing positively to the successful execution of construction projects. The findings underscore the importance of these practices in enhancing material management efficiency and project outcomes

Objective 2: Determine the factors unique to the Zambia National Building Society (NBS) context that influence the selection of material management strategies in construction projects.In construction projects, effective material management is critical for ensuring cost-efficiency, timely project completion, and overall project success. The Zambia National Building Society (NBS) operates within a unique context that influences the selection of material management strategies.Statistical Test: Multiple regression analysis, a parametric test, was used to identify and evaluate the significance of factors influencing the selection of material management strategies.Multiple Regression Analysis Multiple regression analysis was conducted to determine the significance of each factor in influencing the selection of material management strategies. The model included all factors as independent variables, with the dependent variable being the effectiveness of material management strategies.Hypothesis:Null Hypothesis (H0): There is no significant relationship between the factors and the selection of material management strategies.Alternative Hypothesis (H1): There is a significant relationship between the factors and the selection of material management strategies.F-value (20.861): The high F-value indicates that the overall model is statistically significant.Sig. (p-value < 0.001): The p-value being less than 0.001 suggests that the predictors collectively explain a significant portion of the variance in project performance. This means the model fits the data well.The regression analysis reveals that several factors significantly influence project performance at the Zambia National Building Society. The most influential factors are quality standards, cost of materials, supplier relationships, and project timelines, all showing strong positive relationships with project performance. Logistics and transportation, regulatory compliance, and environmental considerations also contribute significantly, albeit to a lesser extent. These findings highlight the critical areas NBS should focus on to enhance project outcomes.

Objective 3: Assess the effectiveness of material management strategies utilized by the Zambia National Building Society (NBS) in construction projects.

Effective material management is essential for the success of construction projects. It ensures that materials are available when needed, in the right quantity and quality, thereby reducing waste and controlling costs.Chi-Square TestThe chi-square test was conducted to determine if there are significant differences in the effectiveness ratings of the material management strategies.Hypothesis:Null Hypothesis (H0): There is no significant difference in the effectiveness of the material management strategies.Alternative Hypothesis (H1): There is a significant difference in the effectiveness of the material management strategies. Interpretation: The Pearson chi-square value is 10.292 with 8 degrees of freedom, and the associated p-value is .245. Since the p-value is greater than the conventional threshold of 0.05, we fail to reject the null hypothesis. This indicates that there is no statistically significant difference in the effectiveness ratings of the different material management strategies utilized by NBS. In other words, the observed distribution of effectiveness ratings across the strategies does not significantly differ from what we would expect by chance. Implications: The implication of these results is that all assessed material management strategies - Procurement Planning, Inventory Management, Vendor Management, Material Handling and Storage, and Waste Management - are equally effective in their implementation within the NBS context. This suggests that NBS may be employing a balanced approach to material management, ensuring that no particular strategy is significantly more or less effective than others.

Objective 4: Analyze the specific challenges encountered by the Zambia National Building Society (NBS) in implementing material management strategies within construction projects.Material management plays a pivotal role in ensuring the success of construction projects by reducing costs, minimizing waste, and improving project timelines. However, implementing these strategies is often fraught with challenges that can significantly affect project efficiency and outcomes. Understanding the challenges faced by the Zambia National Building Society (NBS) in implementing material management strategies is crucial for improving project efficiency and outcomesTo determine if there are significant differences in Impact Score across the Challenge Area categoriesANOVAResultsThe ANOVA results provide insights into the variability in impact scores across different levels of challenges.Interpretation:F-value (1.621): The F-value is 1.621, suggesting that there is some variability between the groups, but it is not substantial.Significance (p-value = .203): The p-value of .203 indicates that the differences between the challenge levels are not statistically significant at the 0.05 level. This

implies that the variations in the impact scores are not significantly influenced by the challenge levels.The mean differences between the challenge levels (Low, Moderate, High) are not statistically significant as indicated by the p-values, all of which are greater than 0.05. This suggests that the perceived impact of the challenges does not significantly differ among the levels. Interpretation: The mean impact scores for the Low, Moderate, and High challenge levels are relatively close (6.552 for Moderate, 7.090 for Low, and 7.317 for High). The lack of significant differences suggests that the level of challenges faced does not drastically alter the impact scores.The analysis indicates that the specific challenges encountered by NBS in implementing material management strategies do not significantly impact the effectiveness of these strategies. The ANOVA results show no statistically significant differences in impact scores across different challenge levels. This suggests that NBS has a robust approach to material management that mitigates the effects of varying challenges.The bar graph in Fig 4.7 compares the mean impact scores for various challenge areas encountered by NBS in implementing material management strategies within construction projects. The challenge areas examined include Waste, Vendor, Procurement, Inventory, and Handling/Storage.The graph indicates that Handling/Storage is perceived as the most significant challenge, with the highest mean impact score of 7.4. This suggests that issues related to handling and storing materials are critical obstacles for NBS, potentially affecting the efficiency and effectiveness of material management. Following closely are the challenges of Waste and Inventory, both with a mean impact score of 7.3. This implies that managing waste and maintaining accurate inventory levels are also substantial challenges, likely influencing project costs and timelines.Vendor-related challenges have a mean impact score of 6.9, indicating moderate difficulty in managing vendor relationships and ensuring timely delivery of quality materials. Procurement challenges are perceived as the least impactful, with a mean score of 6.5, though they still represent notable areas for improvement Fig 4.8: Proportion of ResponsesThe pie chart in Fig 4.8 illustrates the proportion of responses identifying specific challenge areas in material management strategies at NBS:The largest proportion of responses indicates that procurement is perceived as a significant challenge area. This highlights potential difficulties in sourcing materials, managing procurement processes, and ensuring timely delivery.Inventory management is identified as the second most prevalent challenge. This reflects issues in tracking material usage, maintaining optimal inventory levels, and avoiding both shortages and overstocking.

Challenges related to vendor management include selecting reliable vendors, negotiating terms, and ensuring consistent quality and timely supply. This area is crucial for maintaining project timelines and quality standards.

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While the smallest proportion, handling and storage challenges still represent significant obstacles. This includes safe and efficient handling of materials, proper storage to prevent damage, and ensuring easy access to materials when needed.

Conclusion and Recommendations

Material management is an important function in productivity of projects. Material management strategies are scientific techniques concerned with planning, organizing and control of materials from their initial purchase to destination. Boopathi (2016) conducted a study on material management using real-time residential projects. The author argued that that the cost of a project increases mainly due to inappropriate material management. In this, project planning, scheduling and budgeting were done. Since he had followed a proper scheduling method there was no increase in the cost of the project. The material cost constitutes 50 % of total cost which is normal. According to Dipak (2014) for inventory management strategies plays a significant role in planning. The research was focused on determining the cost requisite for project arising from poor planning strategies. The mathematical module of ABC Analysis and EOQ gives the significance of material planning and its effects on cost of construction which translates to either a successful completion of projects or failures. This research concluded that with proper planning on the management of materials, the cost of the project will be saved and hence this will be considered a success. Construction projects are some of the most common activities we encounter, yet it is known as one of the most difficult human endeavors. Each project consists of sophisticated and complex processes which need to be carried out by different individuals of different professions who have the skills and knowledge. All the talent and skills have to be channeled towards a common goal to producing the project whereby time and money will be required. To ensure effective delivery there has to be good controls and management of uncertainty. Therefore, one needs to identify the uncertainty related to the project and come up with the best strategy to deliver to enhance the chances of success for the project.

Recommendations

From the findings most of the companies lack adequate planning of the material with only a small percentage adopting an integrated management plan. A systematic and integrated approach is therefore needed to manage materials and minimize the costs associated with poor materials management. All materials management functions should be well integrated and not performed in isolation since they are interrelated and their performance affects each other. This should be implemented by the project managers to minimize on overhead costs and risk of project failure.

Transport and storage was found to be a major concern in most construction companies. Most of them preferred ordering goods in the last minute such that the material could be used up almost immediately for construction processes.

Project managers should ensure minimized delays in construction works by arranging for effective transport means on time. Construction companies should also invest more on storage spaces through containers where the material can be kept safely and this will cut costs incurred in material damage.

The study also established that despite the advancement and widespread use of computer software globally in material storage management, the same is not used in most of the construction companies. On the formal sites only charts and tables with none of them were using computer software.

The study recommends enhanced use of computers in management of materials since they can easily be used in the planning and monitoring of materials management. This can be done by engineers and project managers in charge of the various projects. Codification of the materials should also be encouraged to make use of computers effective. This will help ensure effective handling of materials and projects in line with the existing standards.

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